INDOOR AIR QUALITY ASSESSMENT

Lawrence Juvenile Court
10 Railroad Street
Lawrence, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

In response to a request from court employees, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) conducted an evaluation of the indoor air quality at Lawrence Juvenile Court (LJC), 10 Railroad Street, Lawrence, Massachusetts on June 29, 2001. The evaluation followed a discussion with Christopher McQuade of the Administrative Office of the Trial Court. Michael Feeney, Chief of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA, conducted the inspection. Concerns related to potential mold exposure from flooding in the basement prompted the request. Courthouse staff reported that rainwater accumulated to a depth of four to six inches throughout the basement floor after a substantial rainstorm during the weekend of Father's Day, June 17, 2001.

The LJC is located in a two-story, red brick building that reportedly was formerly a cookie factory. The building was converted into office space and has served as the LJC for the past several years. The second and first floor contain juvenile courtrooms and related office space. The building does not have openable windows.

Methods

Air tests for carbon dioxide, carbon monoxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor. Moisture content of building materials was measured using a Delmhorst, BD-2000 Model, Moisture Detector.

Results

The LJC has a population of approximately 30 employees and is visited daily by several hundred members of the public. Tests were taken under normal operating conditions and results appear in Tables 1-2.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were above 800 parts per million parts of air [ppm] in 11 out of 15 areas sampled. These carbon dioxide levels are indicative of inadequate fresh air supply in the building. Please note that carbon dioxide measurements were taken on a Friday afternoon with minimal building occupancy, which can greatly reduce carbon dioxide levels.

Ventilation is provided by a heating, ventilation and air-conditioning (HVAC) system. Fresh air is supplied by air handling units (AHUs) located in mechanical rooms on each floor of the LJC and distributed to occupied areas by ceiling mounted air diffusers. Outside air intakes are located on the exterior wall of the mechanical rooms on each floor.

Exhaust ventilation on each floor is provided by ducted, return air vents that are connected to each air-handling unit. Exhaust vents are also located on the exterior wall of the mechanical rooms on each floor of the LJC. Of note is the location of the fresh air intake to the exhaust vent. The larger vent appears to be the fresh air intake (see Picture 1). The smaller vent was found to be ejecting air from the building. In this configuration, it is likely that the fresh air intake is capturing air from the exhaust vent (called short-circuiting), resulting in the recirculation of building pollutants, including waste heat, water vapor and carbon dioxide. In addition, odors from one section of a floor can be distributed to other areas of the floor serviced by the AHU.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of occupancy. In order to have proper ventilation with a mechanical ventilation system, the system must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The date of the last balancing of these systems was not available at the time of the assessment. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings ranged from 69^{o} to 74^{o} F. The BEHA recommends that indoor air temperatures be maintained in a range of 70^{o} to 78^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity in the building was within the BEHA recommended comfort range of 40 to 60 percent in all areas sampled the day of the assessment. Relative humidity measurements ranged from 45 to 66 percent. It is important to note however, that relative humidity measured indoors exceeded outdoor measurements (range +3-4 percent). The increase in relative humidity can indicate that the exhaust system alone is not operating sufficiently to remove normal indoor air pollutants (e.g., water vapor from respiration) as well as water from flood damaged building materials. Moisture removal is important since the sensation of heat conditions increases as relative humidity increases (the relationship between temperature and relative humidity is called the heat index). As indoor temperature rises, the addition of more relative humidity will make occupants feel hotter. If moisture is removed, the comfort of the individuals is increased.

Removal of moisture from the air, however, can have some negative effects. Relative humidity in the building would be expected to drop below comfort levels during the heating season. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a common problem during the heating season in the northeast part of the United States.

Microbial Growth/Moisture Concern

Remediation recommendations concerning flooding in the basement offices were previously made in a letter to the Honorable Barbara Dortch-Okara (MDPH, 2001, Appendix A). Building management staff indicated that accumulated rainwater from Current Hill Road rolled down an embankment (see Pictures 2 and 3) at a rate that overwhelmed the existing parking lot drain. As water filled the parking lot, water ran down the garage ramp (see Picture 4) and penetrated into the cellblock, cellblock control center and front lobby.

Wall-to-wall carpeting adjacent to exterior door thresholds near the south exterior wall of the building appeared to be water damaged (see Picture 7). In addition, water coolers located on wall-to-wall carpeting were noted in offices (see Picture 8). Use of the water cooler can result in chronic moistening of carpeting. Water damaged carpeting can serve as mold growth media. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Water-damaged porous materials cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy materials is not recommended.

A number of water damaged ceiling tiles were noted on the second floor (see Picture 6). Water-damaged ceiling tiles can provide a medium for microbial growth especially if wetted repeatedly. These materials should be replaced after a water leak is discovered.

Plants were noted on windowsills resting on paper towels (see Picture 5). Moistened plant soil, drip pans and standing water can serve as a source of mold growth. Moistened paper can also be a mold growth medium. Plants should be equipped with drip pans and over watering should be avoided.

Conclusions/Recommendations

In view of the findings at the time of the visit, the following recommendations are made:

1. Implement corrective actions recommended in letter concerning flooding as soon as possible (see Appendix A).
2. Measures should be taken to direct water away from the parking lot. Examine the feasibility of creating a levee at the top of the parking lot embankment to prevent flooding of the parking lot. Another consideration would be to create a slope to raise the level of the top of the garage driveway.

3. To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of occupancy independent of thermostat control.
4. Consult a ventilation engineer to maximize the operation of the building's HVAC system. Have HVAC firm fully evaluate existing ductwork system for function to ensure proper distribution of fresh outside air to occupied areas.
5. The feasibility of retrofitting a combination hood/duct to the exterior of the building to direct exhaust air away from fresh air intakes should be examined (see Figure 1).
6. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
7. Replace water damaged ceiling tiles. This measure will remove actively growing mold colonies that may be present. Ceiling tiles should be removed at a time when employees are not present in the workplace. Contain the area where ceiling tiles are removed to prevent the spread of dust and mold spores in the workplace. This practice should be conducted routinely.

8. Ensure all plants are equipped with drip pans. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial where necessary. Consider reducing the number of plants.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

BOCA. 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials and Code Administrators International, Inc., Country Club Hill, IL. Section M-308.1.1.

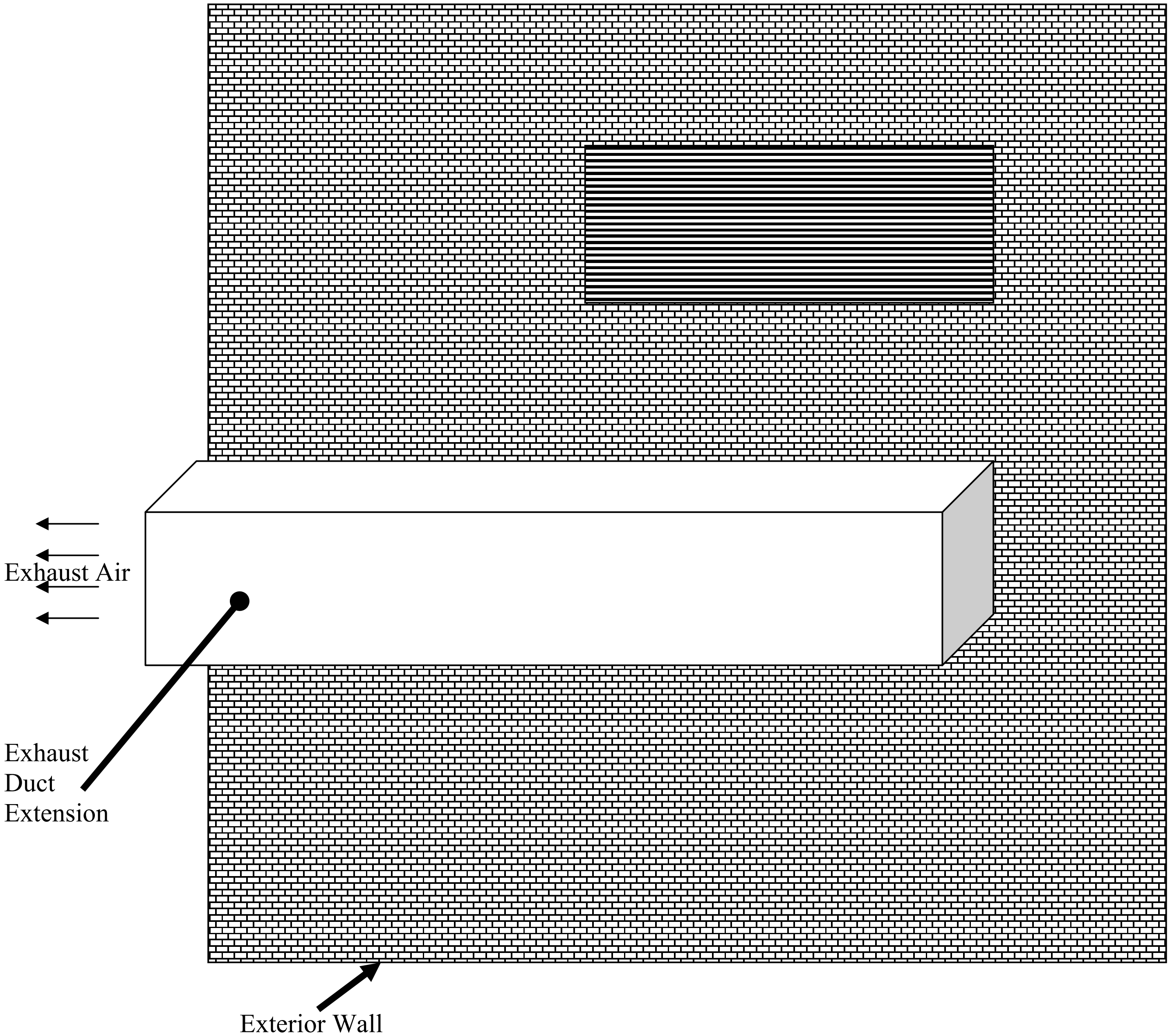
MDPH. 2001. Letter to The Honorable Barbara Dortch-Okara, Chief Justice for Administration and Management, Administration Office of the Trial Court from Suzanne K. Condon, Assistant Commissioner, BEHA, Regarding Water Damage and Microbial Growth at the Lawrence Juvenile Court, 10 Railroad Street, Lawrence, Massachusetts. Dated July 11, 2001. Massachusetts Department of Public Health, Bureau of Environmental Health Assessment, Boston, MA.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

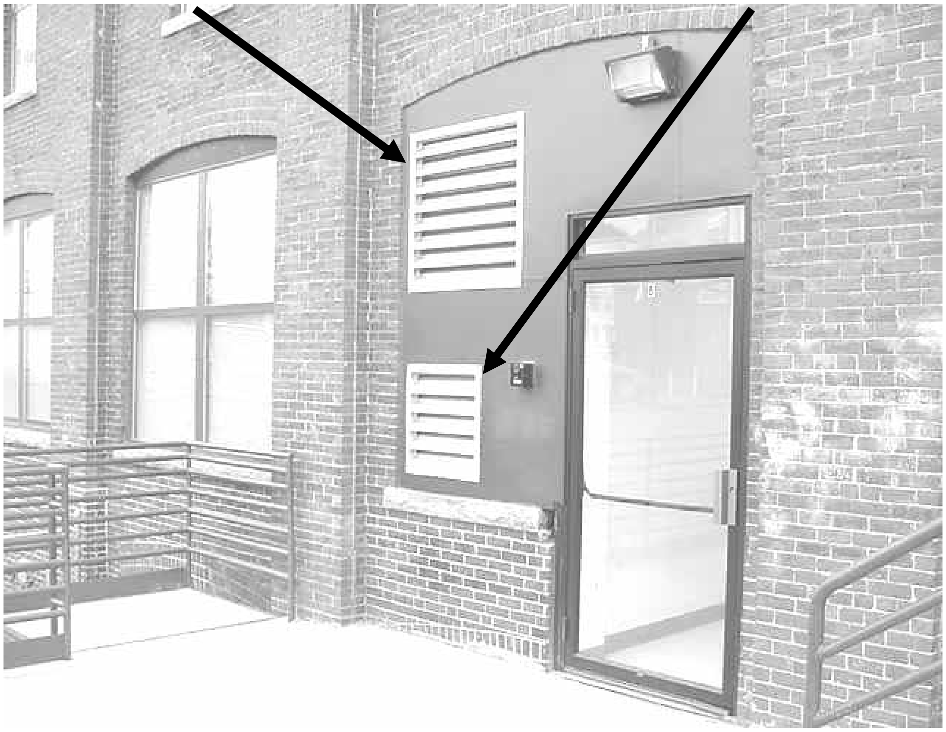
SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

Figure 1 **Possible Reconfiguration of Exhaust Vent**



Picture 1

Fresh Air Intake **Exhaust Vent**



Fresh Air Intake and Exhaust Vents

Picture 2

Flood Water Entered Parking Lot down This Embankment

Picture 3

Parking Lot From the Top of the Embankment

Picture 4

Garage Ramp Sloping down from Parking Lot

Picture 5

Plants Noted on Paper Towels on Windowsills

Picture 6

Water Damaged Ceiling Tiles in Second Floor Lobby

Picture 7

Water Damaged Carpeting Adjacent to Exterior Door Thresholds near the South Exterior Wall of the Building

Picture 8

Water Coolers Located on Wall-To-Wall Carpeting

TABLE 1

Indoor Air Test Results – Lawrence Juvenile Court, Lawrence, MA – June 29, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	498	76	43					
Court Room 2	840	69	42	0	No	Yes	Yes	
2nd Floor Hallway	925	69	43	2	No	Yes	Yes	
Pretrial Conference Room	888	69	43	0	No	Yes	Yes	
Clerk Magistrates	962	71	42	3	No	Yes	Yes	
Storage	671	71	48	0	No	Yes	Yes	
Judge's Lobby	891	70	39	0	No	Yes	Yes	
Judge's Secretary	942	72	40	0	No	Yes	Yes	Plant
Conference Room – Clerks	983	72	40	0	No	Yes	Yes	
Probation	963	73	40	4	No	Yes	Yes	
Probation (SE office)	972	73	39	0	No	Yes	Yes	

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results – Lawrence Juvenile Court, Lawrence, MA – June 29, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Probation (NE Office)	940	73	38	0	No	Yes	Yes	
West Stairwell	691	73	46	0	No	Yes	Yes	
Lobby	727	74	47	0	No	Yes	Yes	
Control Room	808	74	47	3	No	Yes	Yes	
Cellblock Hall	675	72	46	2	No	Yes	Yes	

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